WHAT IS CLAIMED IS:

1. A retardation element having an optical axis and consisting of an alkaline-earth metal fluoride crystal having a <110> crystal axis, the optical axis pointing approximately in the direction of the <110> crystal axis of the crystal or a main crystal axis equivalent thereto.

2. The retardation element as claimed in claim 1, wherein the alkaline-earth metal fluoride crystal is one of a calcium fluoride crystal and a barium fluoride crystal.

3. The retardation element as claimed in claim 1, wherein the retardation element is a retardation plate having an entry face for incident light and an exit face for exiting light and an optical axis substantially perpendicular to the entry and exit faces.

4. The retardation element as claimed in claim 3, wherein the retardation element is one of a $\lambda/2$ retardation plate and a $\lambda/4$ retardation plate.

5. The retardation element as claimed in claim 4, wherein the retardation plate is one of a $\lambda/2$ retardation plate of zeroth order and a $\lambda/4$ retardation plate of zeroth order.

6. The retardation element as claimed in claim 1, wherein the retardation element is a retardation plate, the retardation plate having a thickness variation of at least of up to 2% and up to 1 mm.

7. The retardation element as claimed in claim 1, wherein the retardation element is a retardation plate having an entry face for incident light and an exit face for exiting light, wherein at least one of the entry face and the exit face is provided with a refractively or diffractively active structure or shape.

8. The retardation element as claimed in claim 1, wherein the retardation element has a diameter in the range from 50 to 300 mm.

9. The retardation element as claimed in claim 1, wherein the retardation element is mounted in an unstressed fashion.

10. The retardation element as claimed in claim 1, wherein the retardation element is designed as a lens element with a positive or negative refracting power.

11. The retardation element as claimed in claim 1, wherein the retardation element is designed as a meniscus-shaped lens with a negative refracting power.

12. The retardation element as claimed in claim 1, wherein the retardation element has two optical faces, a shape of the optical faces and an installation position of the retardation element in an optical system being adapted to one another in such a way that the light path of beams inside the retardation element is larger between the optical faces the larger the angle is between a penetrating beam and the optical axis of the retardation element.

13. The retardation element as claimed in claim 1, the retardation element being a lens made from a cubic crystal material with intrinsic birefringence and having a radius and a thickness, wherein as a function of the radius, the thickness has an approximately parabolic profile with radially increasing thickness.

14. A catadioptric projection objective, having at least one retardation element as claimed in claim 1.

15. A catadioptric projection objective for imaging a pattern arranged in an object plane of the projection objective into the image plane of the projection objective arranged between the object plane and the image plane, comprising:
a catadioptric objective part having a concave mirror and a beam splitter with a beam splitter surface;
a retardation device having the action of a $\lambda/4$ plate and being arranged between the beam splitter surface and the concave mirror;
the retardation device having at least one retardation element that is designed as a lens and consists of a cubic crystal material having intrinsic birefringence, the optical axis of the retardation element being aligned approximately in the direction of a <110> crystal axis of the crystal.

16. The projection objective as claimed in claim 15, wherein the retardation element is made of one of a calcium fluoride crystal and a barium fluoride crystal.

17. The projection objective as claimed in claim 15, wherein at least one retardation element is designed as a meniscus-shaped lens with negative refracting power.

18. The projection objective as claimed in claim 15, wherein at least one retardation element has two optical faces, the shape of the optical faces and the installation position of the retardation element being adapted to one another in such a way that the light path of beams inside the retardation element is larger between the optical faces the larger the angle is between a penetrating beam and the optical axis of the retardation element.

19. The projection objective as claimed in claim 15, wherein the retardation element has a radius and a total thickness and wherein, as a function of the radius, the total thickness of the retardation element has an approximately parabolic profile with radially increasing total thickness.

20. The projection objective as claimed in claim 15, wherein the retardation device is arranged in the vicinity of a pupil plane of the projection objective.

21. The projection objective as claimed in claim 15, wherein the retardation device is arranged in the vicinity the concave mirror.

22. The projection objective as claimed in claim 15, wherein no $\lambda/4$ plate is arranged between the beam splitter and the concave mirror.

23. A microlithography projection exposure machine, comprising an illumination system and a projection objective for imaging a pattern-bearing mask onto a photosensitive substrate, wherein the microlithography projection exposure machine has at least one retardation element as claimed in claim 1.

24. The microlithography projection exposure machine as claimed in claim 23, wherein the illumination system has a retardation element as claimed in claim 1.

25. A method for producing semiconductor componentscomprising utilizing a microlithography projection exposure machine as claimed in claim 23.

26. A retardation plate comprising:

a birefringent crystal plate, the crystal plate having an entry face for incident light and an exit face for emerging light and an optical axis; wherein

the crystal plate consists of an alkaline-earth metal fluoride and has a <110> crystal axis ;

the optical axis of the retardation plate is aligned at least approximately in the direction of the <110> crystal axis or of a substantially equivalent principal crystal axis; and

a form-birefringent layer structure is applied to at least one of the entry face and the exit face.

27. The retardation plate according to claim 26, wherein the form-birefringent layer structure is configured as a periodic sequence of at least two dielectric layers with alternating refractive indices.

28. The retardation plate according to claim 27, wherein a thickness (d) of the layers is less than the wavelength for which the retardation plate is designed.

29. The retardation plate according to claim 28, wherein the thicknesses (d) of the layers are less than 1/5 of the wavelength for which the retardation plate is designed.

30. The retardation plate according claim 27 , wherein all the layers have the same thickness (d).

31. A retardation plate comprising:
a birefringent crystal plate, the crystal plate having an entry face for incident light and an exit face for emerging light and an optical axis perpendicular to the entry face and the exit face; wherein
the crystal plate consists of one of calcium fluoride (CaF_2) and barium fluoride (BaF_2) fluoride and has a <110> crystal axis ;
the optical axis of the retardation plate is aligned at least approximately in the direction of the <110> crystal axis or of a substantially equivalent principal crystal axis; and
a form-birefringent layer structure is applied to at least one of the entry face and the exit face.

32. A retardation element having an optical axis and consisting of one of a calcium fluoride crystal and a barium fluoride crystal having a <110> crystal axis, the optical axis pointing approximately in the direction of the <110> crystal axis of the crystal or a main crystal axis equivalent thereto, wherein:

the retardation element is a retardation plate having an entry face for incident light and an exit face for exiting light and an optical axis substantially perpendicular to the entry and exit faces; and

the retardation element is one of a $\lambda/2$ retardation plate and a $\lambda/4$ retardation plate.